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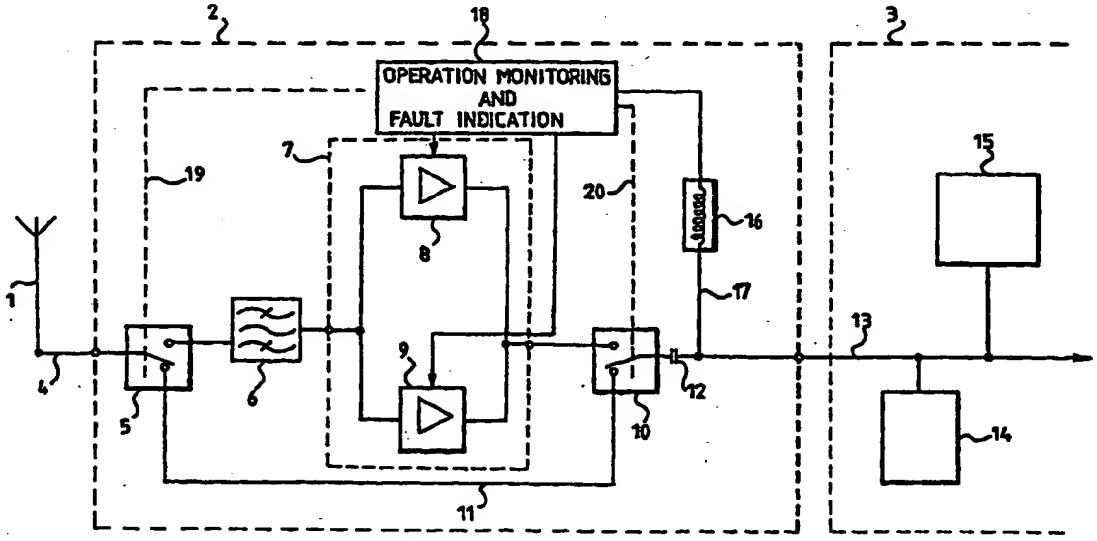

(57) Abstract

The present invention relates to an amplifier unit intended to be connected between an antenna and a receiver unit. The amplifier unit enables the condition of a receiver antenna to be monitored without it being necessary to decouple the amplifer unit from the antenna line. The antenna amplifier functions in the measurement of the condition of an antenna in such a manner that the bypass switching means located in the antenna amplifier are controlled from the receiver unit via the antenna line to establish a bypass connection. The switching means thus return to the home-position, disconnecting the antenna amplifier section from the signal path and connecting a low-loss transmission line to the signal at the same time. Now the condition of the antenna can be measured via the antenna cable by a measurement operation integrated into the receiver unit without the antenna amplifier affecting the measurement result.

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Antenna amplifier for receiving frequencies

Field of the Invention

The present application relates to an amplifier unit intended to be connected between an antenna and a receiver unit. The amplifier unit amplifies a signal received from the antenna and enables the condition of the receiver antenna to be monitored.

Background of the Invention

Receiver and transmitter antennas are an essential part of radio systems, for instance cellular radio telephone systems and their base stations. In order to improve the sensitivity of a radio receiver, an antenna amplifier or pre-amplifier is often located at the top of an antenna tower in the immediate vicinity of the antenna in order to enable the amplification of a signal received by the antenna before it is applied along an antenna cable to the actual receiver located at the base of or in the vicinity of the antenna tower.

Since the condition of an antenna influences the quality of connections, one tries to monitor it in different ways. By the methods currently in use, the condition of antennas can be monitored for instance by measuring the standing wave ratio, i.e. the electric matching of the antennas to the remaining part of the receiver and transmitter system. The condition of a receiver antenna can also be measured by transmitting a radio-frequency test signal via an antenna line to the antenna and measuring the magnitude of the test signal component reflected from the antenna along a measuring route.

The amplifier technology currently commercially available has, however, significant disadvantages, which manifest themselves in such a manner that amplifiers do not enable the measurement of the condition of a

receiver antenna without disconnecting the amplifier from the antenna line, inserting a measuring device between the antenna and the amplifier, or transmitting a separate test signal via a line mounted for this purpose. Usually, it is only when the reception is interrupted that a failure in an antenna located on a tower is discovered, however. If there is a failure in an amplifier section of the prior art antenna amplifiers, the receiving sensitivity of the receiver unit is tens of decibels lower or totally lost, in which case a radio link between for instance a mobile telephone and a receiver unit is broken, and the system is no longer operative.

Disclosure of the Invention

The object of the present invention is to obviate the disadvantages associated with the prior art and to provide a totally new type of solution by which the amplifier section can be bypassed and the measurement carried out from the ground surface. Furthermore, when there is a failure in the amplifier, the receiving sensitivity of the receiver unit decreases only by the attenuation of the antenna cable, which corresponds to a situation where no antenna amplifier is provided.

To put it more accurately, the amplifier apparatus of the invention is characterized in that the bypass switching means are controlled by the receiver unit via the antenna line to establish a bypass connection, the switching means thus returning to the home-position, disconnecting the amplifier section from the signal path and connecting a low-loss transmission line to the signal to measure the condition of a receiver antenna.

The antenna amplifier according to the invention operates in the measurement of the condition

of an antenna in such a manner that upon receiving a command to carry out the measurement of the condition of the antenna, the bypass switching means are controlled from the receiver unit via the antenna line to switch a bypass connection. The relays or switches thus return to the home-position, disconnecting the amplifier section from the signal path and connecting a low-loss transmission line to the signal. Now the antenna can be "seen" via the antenna cable by the receiver unit, and the condition of the antenna can be measured by a measurement operation integrated into the receiver unit.

The bypass connection may be established by switching off the supply voltage of the antenna amplifier by the receiver unit. Another alternative is to decouple the antenna cable from the receiver unit, whereby the power supply to the antenna amplifier is cut off. The relays or switches thus return to the home-position, disconnecting the amplifier section from the signal path and connecting a low-loss transmission line to the signal, and the condition of the antenna can be measured by a separate measuring device.

The bypass switching means may also be controlled by a control signal applied from the receiver unit via the antenna line. This control may be accomplished for instance by tone-frequency technology, the receiver unit thus giving a tone-frequency control command to the antenna amplifier located on a tower, and the relays or switches change their state; and a bypass connection is thus established.

A circuit that monitors the condition of the amplifier section is part of the antenna amplifier of the invention. When the circuit observes that the operation of the amplifier section has deteriorated in such a degree that the predetermined limit is exceeded,

the relays are controlled to return to the home-position by the circuit. The amplifier section is thus disconnected from the signal path, and a low-loss transmission line is connected to the signal. The sensitivity of the receiver of the receiver unit will be decreased by the amount of the attenuation of the antenna cable, i.e. usually less than 5 dB. The situation corresponds to one where no antenna amplifier is connected to be used at all.

The gain of the amplifier section of the antenna amplifier may be selected to be as high as desired, the gain of the distribution amplifier located at the receiver unit being thus decreased correspondingly. There are few alternatives as regards the actual bypass connection if the loss of the bypass is desired to be low.

If the gain of the antenna amplifier is very high, the sensitivity of the reception chain deteriorates at least by this gain in a case of a fault, if the bypass option is in use.

Is is preferable to implement the bypass connection by high-frequency relays or connectors.

In the following, the invention will be described in more detail by means of an exemplifying embodiment with reference to the accompanying figure, which shows an equipment according to the invention as a block diagram.

Preferred Embodiments of the Invention

The figure shows an antenna amplifier or pre-amplifier unit 7 located in the immediate vicinity of a receiver antenna 1, for instance on an antenna tower or some other location of an antenna, said amplifier intended to be used for amplifying a radio-frequency signal received by the antenna 1 before the signal is applied via an antenna cable 13 to a receiver unit

located further from the antenna, for instance at the base of or in the vicinity of the antenna tower, it being possible for this receiver unit to be any receiver system as required in each particular case, for instance a base station of a cellular radio telephone system.

An amplifier unit 2 comprises a band-pass filter 6 for separating a desired bandwidth from the signal applied by the antenna 1. The amplifier unit is further secured by doubling. In order to accomplish this, the unit comprises two separate amplifiers 8 and 9, one of which is the amplifier which is in use in each particular case and via which the signal is passed, and the other is a standby unit in full operating state.

A receiver unit 3 includes a power supply unit 14 for applying a supply voltage via the antenna cable 13 to the amplifier unit 2 and via a line 17 to a condition monitoring unit 18. Even though the power supply unit 14 is regarded as belonging operationally to the receiver unit 3, it may in practice be situated separately from the radio parts of the receiver unit. A measuring unit 15 is also placed in connection with the receiver unit, this measuring unit measuring the signal strength and the condition of the antenna.

Switches 5 and 10 are mounted on the input line 4 and output line 13 of the antenna amplifier to enable the amplifier section 7 to be bypassed by connecting a low-attenuation transmission line 11 between the switches 5 and 10 at the same time as the amplifier section 7 is disconnected from the signal path. The switch 5 mounted on the input line 4 is located on the line 4 coming from the antenna 1 before the bandpass filter 6 while the connector 10 mounted on the output line 13 is located before a decoupling capacitor 12.

The bypass switching means may be controlled in several different ways. For instance, it is possible

to cut off the supply voltage of the antenna amplifier, whereby the relays or switches used as switching means 5 and 10 return to the home-position, and a bypass connection is established. The control may also be accomplished by tone-frequency technology, the receiver unit thus giving a tone-frequency control command to the antenna amplifier located on a tower, and the switching means change their state; and a bypass connection is thus established.

By using lines 19 and 20, the condition monitoring logic 18 located in the antenna amplifier controls the relays or switches so that they return to the bypass position when the logic observes that the deterioration of the condition of the amplifier 8 or 9 exceeds the predetermined limit.

While measuring the condition of the antenna 1, the receiver unit cuts off the supply voltage of the antenna amplifier. The switching means 5 and 10 thus return to the home-position, disconnecting the amplifier section 7 from the signal path and connecting a low-loss transmission line 11 to the signal. Now the antenna can be "seen" via the antenna cable 4 and 13 by the receiver unit, and the condition of the antenna can be measured by a measurement operation integrated into the receiver unit.

Another alternative is to decouple the antenna cable 13 from the receiver unit, whereby the power supply to the antenna amplifier is cut off. The switching means 5 and 10 thus return to the home-position, disconnecting the amplifier section 7 from the signal path and connecting a low-loss transmission line 11 to the signal. Now the antenna 1 can be "seen" via the antenna cable 4 and 13 by the receiver unit, and the condition of the antenna can be measured by the measuring unit 15 or by a separate measuring device.

The bypass connection is preferably implemented by high-frequency relays for various reasons. Firstly, the lowest attenuation is thus achieved on the signal path especially as regards the bypass, which improves the reliability of the condition measurement of the antenna. Secondly, relays have best tolerance against for instance energy peaks caused by a lightning. Thirdly, relays operate in home-position without any control whereas semiconductors always require a supply voltage in every position.

The invention is not restricted to the embodiment disclosed in the accompanying figure and the description relating thereto and not merely to the use of radio telephone technology but various modifications of details are possible within the scope of the inventive concept determined by the appended claims.

Claims

1. An amplifier unit intended to be connected between an antenna and a receiver unit, the amplifier unit comprising bypass switching means (5, 10) mounted on input and output lines (4, 13) to bypass an amplifier section (7) by connecting a low-attenuation transmission line (11) between the input and output terminals at the same time as the amplifier section (7) is disconnected from the signal path, c h a r a c t e r i z e d in that the bypass switching means (5, 10) are controlled by the receiver unit (3) via the antenna line (13) to establish a bypass connection, the switching means (5, 10) thus returning to the home-position, disconnecting the amplifier section (7) from the signal path and connecting a low-loss transmission line (11) to the signal to measure the condition of a receiver antenna (1).

2. An apparatus according to claim 1, c h a r a c t e r i z e d in that the control of the switching means (5, 10) is implemented by cutting off the supply voltage to the amplifier unit from the receiver unit (3).

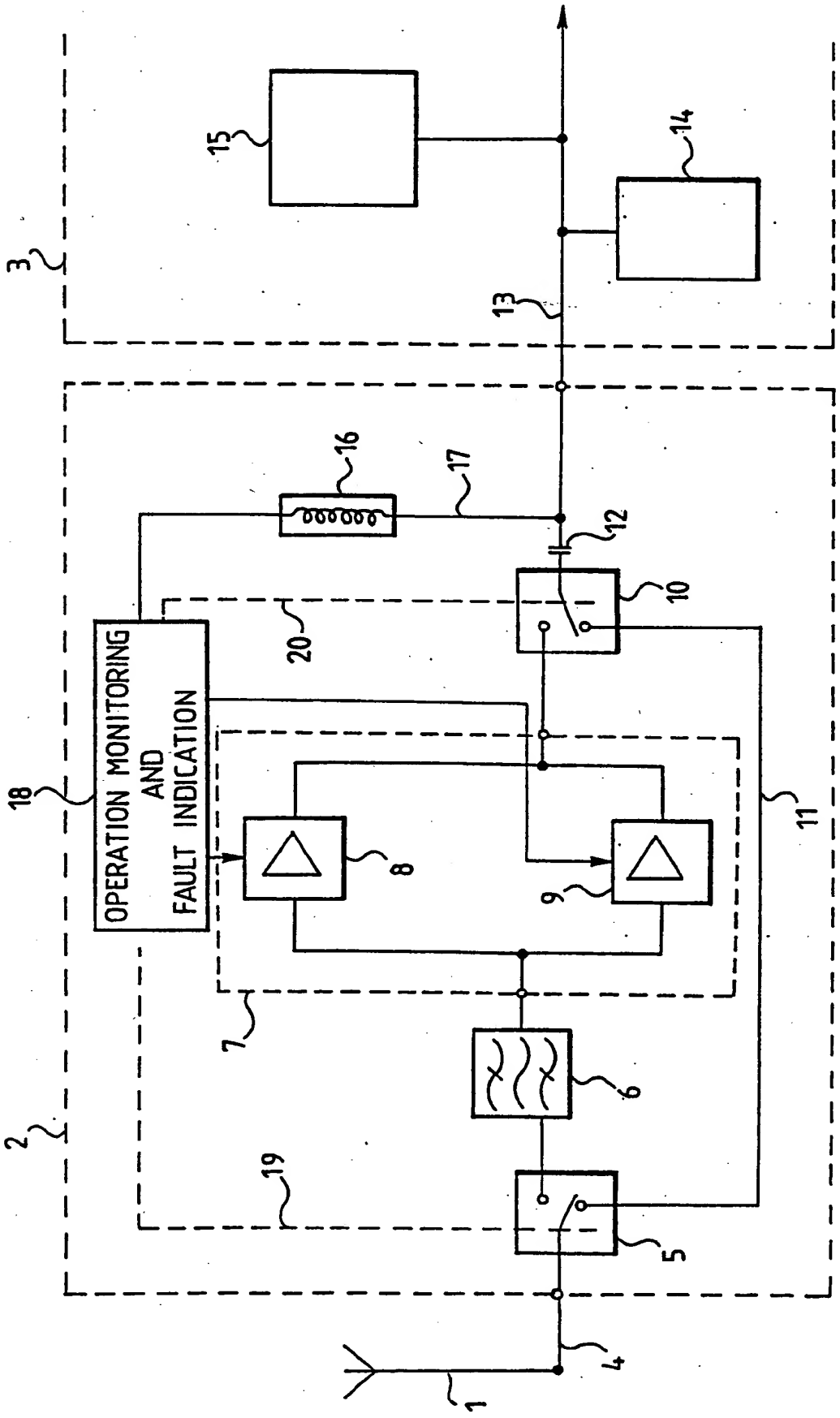
3. An apparatus according to claim 1, c h a r a c t e r i z e d in that the switching means (5, 10) are controlled from the receiver unit (3) by a control signal applied via an antenna line.

4. An apparatus according to claim 3, c h a r a c t e r i z e d in that a tone-frequency signal is used as the control signal.

5. An apparatus according to any one of the preceding claims, c h a r a c t e r i z e d in that the amplifier unit includes a condition monitoring logic (18), which controls the connecting means (5, 10) so that they return to the bypass position when the logic

observes that the deterioration of the condition of the amplifier section (7) exceeds the predetermined limit.

6. An apparatus according to any one of the preceding claims, c h a r a c t e r i z e d in that the bypass connection is implemented by high-frequency relays or connectors.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OPERATION MONITORING AND FAULT INDICATION
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FIG. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 95/00010

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G01R 27/06, H04B 1/18, H03F 1/52
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G01R, H01Q, H03F, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG: WPI, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP, A2, 0447194 (THE GENERAL ELECTRIC COMPANY), 18 Sept 1991 (18.09.91), column 2, line 11 - line 27; column 3, line 9 - line 14; column 3, line 43 - line 46, figure 1 --	1-4,6
Y	US, A, 3060381 (W.C. TURNER ET AL), 23 October 1962 (23.10.62), column 1, line 35 - line 56; column 2, line 51 - line 66, figure 1 --	1-4,6

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Information on patent family members

01/04/95

International application No.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A2- 0447194	18/09/91	GB-A,B- 2242088	18/09/91
		JP-A- 5102874	23/04/93
		US-A- 5230096	20/07/93
US-A- 3060381	23/10/62	NONE	